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Pull the plug

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Original research article

Pull the plug: How private commitment strategies can strengthen personal norms and promote energy-saving in the Netherlands

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ABSTRACT

We tested the influence of a private commitment strategy, in which people pledge to change their behaviour, on energy saving behaviour. We found that the private commitment only influenced energy saving behaviour when the behaviour was perceived to be relatively effortful. When people found it easy to engage in the behaviour, the private commitment did not promote energy saving behaviour. Importantly, we tested the underlying mechanism why private commitments may influence energy saving in households. Our results show that when behaviours are perceived to be relatively effortful, the private commitment strengthened people's personal norm to engage in the behaviour. That is, after making a private commitment they felt more morally obliged to engage in the behaviour they committed to. In turn, a stronger personal norm was positively related to energy saving behaviour. People's injunctive norms and environmental self-identity did not explain why making a private commitment changed energy saving behaviour when this behaviour is perceived to be relatively effortful. Our findings contribute to the literature by providing more insight into why and under which circumstances private commitments may influence behaviour. Our results suggest that only when people find the behaviour somewhat effortful a private commitment may increase their personal norm to engage in the behaviour, thereby making it more likely that they actually do so.

1. Introduction

To combat environmental problems it is important that people change their behaviour towards more sustainable energy behaviour [1]. Energy use is one of the main causes of CO₂ emissions. Households consume 26% of the direct energy consumption in Europe [2]. Therefore, an important question to answer is which types of interventions or policies can effectively stimulate people to engage in energy saving behaviour. Social sciences can contribute to the reduction of such problems and provide important insights into strategies effectively targeting these problems [3,4].

1.1. Commitment strategy

One type of intervention that has been used successfully to promote pro-environmental behaviour, is the use of a private commitment strategy [5]. With a private commitment, people promise or pledge to change their behaviour. For example, people may promise to switch off their household appliances, instead of leaving them on standby. Making

such a commitment has been found to effectively promote a diverse range of pro-environmental behaviours such as changing transportation mode [6,7], recycling [8–12], and reducing towel use [13,14]. Private commitments have also been found to reduce energy use [15–19]. Although many studies have shown that private commitment strategies can effectively promote desired behaviour, it is yet unclear why this strategy is effective [5,20]. If we understand why private commitment strategies can be effective in changing behaviour, such as energy saving behaviour, private commitment strategies can be adapted in such a way that they are more likely to change the underlying mechanism and lead to larger behavioural changes. That way, private commitment strategies are more likely to effectively change behaviour. In the current study, we therefore examine the process or mechanism underlying the effectiveness of private commitments.

1.2. The process explaining the effectiveness of a private commitment strategy

A number of processes have been proposed that may explain why

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commitment strategies can change behaviour: (1) by increasing the extent to which you think others expect you to act upon the behaviour you committed to, (2) by changing how you see yourself, and 3) by increasing one's moral obligation to act upon the commitment [5,20,21]. The extent to which you think others expect you to engage in a behaviour has been defined as injunctive norms. Injunctive norms have been found to influence household energy use (e.g. [22,23]). That is, when you learn that (important) others expect you to save energy you are more likely to reduce your household's energy consumption. However, we expect that a private commitment is not likely to strengthen the extent to which you think important others expect you to save energy. Making a commitment may only increase the extent to which you think others expect you to act upon the commitment when other people are aware of your commitment. Commitments can be made publicly or privately. When people make a public commitment, others are aware of this commitment and are therefore more likely to expect that person to change the behaviour they committed to. However, when people make a private commitment, others are not aware of the commitment made. Therefore, others are not more likely to expect that person to act upon the commitment and change the behaviour committed to, as they do not know that the commitment was made in the first place. We thus expect that a private commitment is not likely to change behaviour by increasing the extent to which you think others expect you to engage in the behaviour (i.e. injunctive norms).

Furthermore, we argue that making a private commitment is not likely to lead to changes in how you see yourself. In this case, we expect that making a private commitment to save energy is not likely to change the extent to which you see yourself as a pro-environmental person (i.e. environmental self-identity). Research has shown that past pro-environmental actions may change the extent to which people see themselves as a pro-environmental person, which in turn promotes pro-environmental behaviour [24,25]. However, this is only likely to occur when the behaviour strongly signals that one is a pro-environmental person [26]. For example, this was only found to be the case when people engage in many (in this case, eight) different pro-environmental behaviours as opposed to one pro-environmental behaviour, or when they engage in a difficult and unique behaviour as opposed to when the behaviour was easy and not unique [27]. If one commits to a very difficult pro-environmental behaviour or to many different pro-environmental behaviours, this may function as a signal that one is a pro-environmental person. However, when people commit to only a single pro-environmental behaviour or to a few easy behaviours the private commitment is not likely to signal that you are a pro-environmental person and thus not likely to change the extent to which you see yourself as a pro-environmental person.

How you see yourself may not only refer to the extent to which you see yourself as a pro-environmental person, it may also refer to whether you are consistent. When people have made a private commitment to save energy they may want to be consistent and feel obliged to act in line with this private commitment. Therefore, we argue that the process underlying the effectiveness of private commitments is the effect that private commitments have on one's moral obligation to act in line with the commitment and thus to engage in the behaviour one committed to. That is, we propose that private commitments influence the personal norm to act upon the commitment. Personal norms refer to the extent to which people feel morally obliged to engage in certain behaviour [28]. Experiencing a stronger personal norm to engage in pro-environmental behaviour has been found to be related to pro-environmental behaviours [29–31]. We propose that private commitments are likely to increase the extent to which people feel morally obliged to act upon the commitment, as in that case people promise to themselves that they will engage in a certain behaviour.

Two papers on the influence of commitment on cooperation in a social dilemma support our reasoning that private commitments may strengthen one's personal norm to engage in the behaviour [32,33]. These studies showed that participants who made a commitment to

engage in cooperative behaviour were likely to make cooperative choices when their choices were made publicly. However, they were also likely to do so when the choices were made privately. The authors' explanation for this effect is that the commitment strengthened a personal norm to engage in this behaviour. The findings indeed suggest that the motivation to act upon the commitment came from within the participant and did not depend on external factors such as social pressure. This is in line with our reasoning that a private commitment may make people feel morally obliged to engage in the behaviour (i.e. strengthen their personal norm). However, as the authors did not directly test this explanation, the question remains whether making a private commitment strengthens one's personal norm to engage in the behaviour one committed to and whether personal norms in turn strengthen the behaviour.

1.3. Present research

We will test whether, and why a private commitment strategy can promote the behaviour one committed to. Specifically, we will test whether a private commitment influences the desired behaviour through strengthening the injunctive norm to do so, the extent to which people see themselves as a pro-environmental person, or one's personal norm to do so. We expect personal norms to be the mechanism underlying the effectiveness of private commitment strategies. We implemented the private commitment in a field setting and measured the behaviour one month later using an online questionnaire. We focused on switching off appliances instead of leaving them on standby because this is a behaviour most people in the household have control over and can change in a month. Furthermore, in the European Union, approximately 19 million tonnes of CO₂ per year is emitted due to appliances in standby mode [34]. Reducing the number of household appliances in standby mode can therefore contribute to reducing environmental problems.

2. Methods

2.1. Participants and procedure

Participants were approached in the educational centre of the zoo 'Ouwehands Dierenpark' in the Netherlands. Volunteers and the three authors of this paper asked visitors whether they were willing to participate in a study of a university in the Netherlands. This was done each Wednesday, Saturday and Sunday and every day of the week during school holidays over a period of 5 months. Visitors who agreed to participate were asked to take a moment to look at a poster providing information about the energy use of appliances and the relationship between energy use and climate change.¹ Next, they were asked to complete an online questionnaire, including questions about their perception of the posters and the emotions they experienced at that moment. Randomly, half of the participants were then asked to commit to unplugging electrical appliances at home when they were not being used, details regarding the private commitment can be found below. At the end of the questionnaire, participants were asked for their e-mail address through which we could approach them for the second part of the study. We kept the first questionnaire as concise as possible in order to increase the response rate. In total 342 visitors completed this first part of the study of which 179 were in the private commitment condition and 163 in the control condition (see Fig. 1).

All participants were sent the second part of the study by email one

¹ In addition, one third of participants were presented with a poster showing factual information on the environmental consequences of climate change, and one third of the participants were presented with a poster showing a polar bear on ice with the statement 'Help save me, pull the plug'. We did not find any effects of the poster on switching off appliances or any of the other variables.

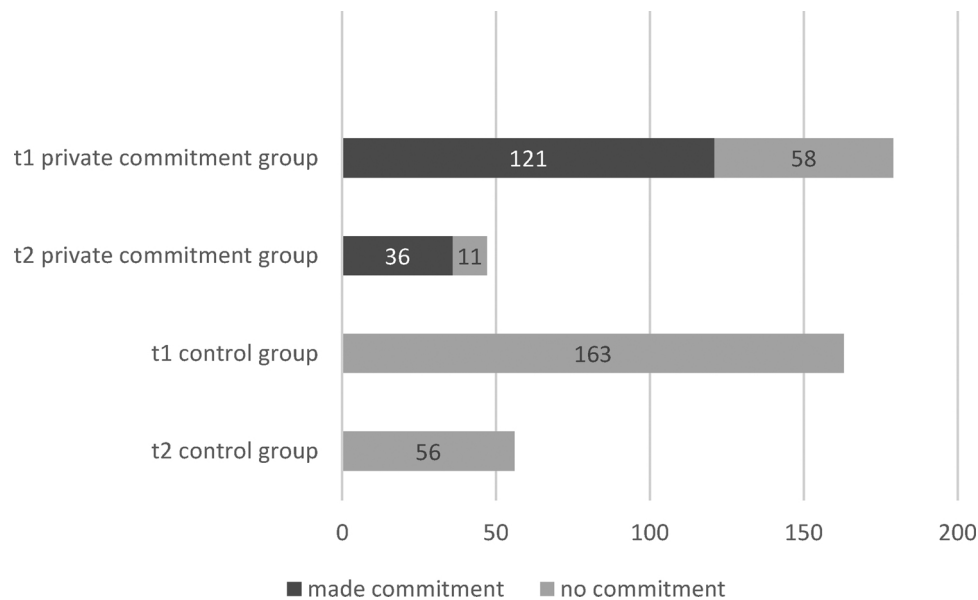


Fig. 1. Participants at t1 and t2 per group.

month after they had completed the first part in the zoo. In this second part of the study, we measured switching off electrical appliances in the past month, injunctive norms, environmental self-identity, personal norms, and perceived effort to switch off appliances. We also included measures on values, emotions, self-efficacy, involvement in environmental issues, and perceived consequences of switching off appliances. In total 103 participants completed both questionnaires of which 47 were in the private commitment condition and 56 in the control condition (see Fig. 1). Of these participants, 51 were male, 44 female and 8 participants did not indicate their gender. Age ranged from 18 to 75 years old ($M = 46.7$, $SD = 13.99$). Most participants were either living together with a partner (33%) or with partner and children (45%); 8% of the participants were living alone. About 8% of the respondents did not complete any formal education, or completed primary education or vocational secondary school, while 31% had completed the highest level of secondary school or vocational education and 53% finished university. Around 17% of the sample indicated that their monthly net household income was less than 2000 Euros, 58% between 2000 and 4000 Euros, while 25% earned more than 4000 Euros per month. Compared to the Dutch population the sample contained less single households, completed a higher level of education and income level was slightly higher than the average in the Netherlands [35]. The study sample is representative for the Dutch population in terms of gender and age.

2.2. Private commitment at time 1

In the zoo, half of the participants were randomly assigned to the experimental condition, in which they were asked to make a private commitment to unplug appliances. The other half was assigned to the control condition in which they were not presented with the private commitment. The introduction of the private commitment explained that appliances left on standby use more energy than appliances that are completely turned off when not being used. Next, we presented participants with a list of appliances (e.g., mobile phone charger, computer, television²). Furthermore, participants could add appliances of their own choice if they were not listed. Participants were asked to

tick the box(es) of those appliances they committed to unplug when not in use for the next month. For each appliance, they could tick a box to indicate that they committed to switching off the appliance in the coming month. Participants could also indicate whether they already switch off the appliance and plan to continue doing so. As we are interested in whether a private commitment can lead to changes in household energy saving behaviour we did not include commitments to plan to continue switching off appliances in our analyses, as the desired behaviour was already performed for these stand-by actions.³ Commitments are more effective when the commitment is active instead of passive [21], therefore we asked participants to ‘sign’ the online form by typing in their name and the date. Of the final sample, participants on average committed to start switching off 3.5 ($SD = 4.00$) appliances. Participants committed to start switching off the following appliances: television ($N = 19$), microwave ($N = 16$), coffee machine ($N = 15$), printer ($N = 15$), laptop ($N = 13$), cooker ($N = 13$), mobile phone ($N = 12$), CD player ($N = 12$), DVD player ($N = 12$), computer ($N = 11$), amplifier ($N = 11$), laptop ($N = 10$), computer speakers ($N = 9$), portable radio ($N = 9$) and game console ($N = 8$). Of the 47 participants in the private commitment condition 11 participants did not commit to start switching off any appliances (see Fig. 1).

2.3. Measures at time 2

Use of appliances. Participants were asked how often they completely switched off appliances (‘How often did you completely switch off the following appliances in the past month when they were not used?’). We asked participants to report this for all appliances. Participants could answer on a scale from 1 (never) to 7 (always; $M = 5.65$, $SD = 1.16$). For the participants who were not asked to make a private commitment we took the average of all appliances ($M = 5.54$, $SD = 1.26$). For the participants who were asked to make a private commitment we computed the average of those appliances for which a participant made a commitment to start switching off this appliance ($M = 5.50$, $SD = 1.62$). This means that only the 36 participants who committed to switching off new appliances were included in the

² Appliances included were: mobile phone charger, laptop charger, laptop, computer, computer speakers, portable radio, cd player, amplifier, television, DVD player, game console, microwave, coffee maker, cooker, printer.

³ Participants in the commitment condition switched off appliances they indicated they already switch off and will continue to do so more often ($M = 6.18$, $SD = 1.03$) than participants in the control group switched off all appliances ($M = 5.54$, $SD = 1.26$; $t(93) = -2.64$, $p = .01$, $d = .56$).

analyses.

Perceived ease. To be able to control for the extent to which people feel they are able to switch off appliances we measured perceived ease to switch off appliances (cf. [36]). We used five items (It costs me little effort to switch off appliances at home; I automatically switch off my appliances at home; I easily forget to switch off my appliances at home (recoded); it is feasible for me to switch off my appliances at home; I am able to switch off my appliances at home). Participants answered on a scale from 1 (totally disagree) to 7 (totally agree). The items formed a reliable scale ($\alpha = .83$, $M = 4.99$, $SD = 1.36$).

Personal norm. Personal norm to switch off appliances was measured with three items (I feel morally obliged to switch off appliances at home; It goes against my principles to not switch off appliances at home; I feel good if I switch off appliances at home; see e.g., [31]). Participants answered on a scale from 1 (totally disagree) to 7 (totally agree). The items formed a reliable scale ($\alpha = .72$, $M = 4.14$, $SD = 1.49$).

Injunctive norm. The injunctive norm was measured with three items (People who are important to me expect me to switch off my appliances; My friends and family expect me to switch off my appliances; Other zoo-visitors expect me to switch off my appliances; based on Staunton et al. [37]). Participants answered on a scale from 1 (totally disagree) to 7 (totally agree; $\alpha = .85$, $M = 3.14$, $SD = 1.43$).

Environmental self-identity. We measured the extent to which people see themselves as an environmentally-friendly person with three items (I am the type of person who acts environmentally-friendly; Acting environmentally friendly is an important part of who I am; I see myself as an environmentally friendly person, see e.g., [38]). Participants answered on a scale from 1 (totally disagree) to 7 (totally agree; $\alpha = .90$, $M = 4.51$, $SD = 1.25$).

3. Results

Using IBM SPSS version 24 we first tested whether the private commitment group indeed switched off those appliances for which they made a private commitment more often than the control group switched off appliances in general. Our results show that there is not a main effect of private commitment on switching off appliances. The group who committed to switching off appliances did not switch off those appliances more often ($M = 5.50$, $SD = 1.62$) than the control group switched off appliances in general ($M = 5.54$, $SD = 1.26$; $t(88) = .14$, $p = .89$). However, in line with studies showing that interventions may not effectively change behaviour among all participants [39], we tested and found an interaction between perceived ease and making a private commitment on switching off appliances. That is, we found that the influence of the private commitment on switching off appliances depends on one's perceived ease of the behaviour. We tested the influence of perceived ease (mean centred), the private commitment, and the interaction between perceived ease and the private commitment on switching off appliances (using regression analyses in the PROCESS macro for SPSS; for more details on the statistical model see [40]). The model explained 27.7% of the variance in switching off appliances ($F(3, 82) = 10.47$, $p < .001$). We found a main effect of perceived ease: the easier people find it to switch off their appliances the more likely they are to do so ($b = .43$, $p < .001$). We did not find a main effect of making the private commitment ($b = .03$, $p = .81$). Interestingly, we did find an interaction effect between making a private commitment and perceived ease ($b = -.24$, $p < .05$). We used the Johnson-Neyman technique in Hayes' PROCESS macro to identify the range of perceived ease where the private commitment influences switching off appliances in the past month [41]. The results show that there was a positive effect of making a private commitment on switching off appliances when perceived ease is lower than 3.42 ($B_{JN} = .41$, $SE = .20$, $p = .05$). When perceived ease is higher than 3.42 we did not find an effect of the private commitment on switching off appliances. As can be seen in Fig. 2, when people find it relatively effortful to switch off appliances

(i.e. perceived ease is low) the private commitment increases the switching off appliances. However, this is not the case when people perceive it to be relatively easy to switch off appliances. This suggests there may be a ceiling effect: when switching off appliances is perceived to be relatively easy people already switch off appliances. Therefore, the private commitment may have only been effective when switching off appliances is perceived to be relatively effortful.

Finally, we tested why participants switched off their appliances. We tested whether making a private commitment and its interaction with perceived ease influence switching off appliances via personal norm, injunctive norm and environmental self-identity. We included personal norm, injunctive norm and environmental self-identity in the same analysis (using regression analyses in model 7 of Hayes' PROCESS macro, see Fig. 3). We found that making a private commitment, perceived ease and their interaction is related to switching off appliances via personal norm. The mean indirect effect from the bootstrap analysis ($N = 1000$) was negative and significant ($(a_1 + a_3 \times W) \times b = -.06$; 95% CI $[-.20, -.01]$). More specifically, we found that the private commitment, perceived ease and the interaction between the private commitment and perceived ease explained 21.9% of the variance in personal norm ($F(3, 80) = 7.49$, $p < .001$). The easier people perceive switching off appliances to be, the stronger their personal norm to switch off appliances ($b = .39$, $p < .01$). Making a private commitment did not influence personal norm ($b = -.00$, $p = .98$). However, we did find an effect of the interaction between making a private commitment and perceived ease on personal norm ($b = -.24$, $p < .05$). We found that only when people perceived switching off appliances to be relatively effortful (perceived ease is lower than 2.62), making a private commitment is related to a stronger personal norm to switch off appliances ($B_{JN} = .53$, $SE = .27$, $p = .05$, using the Johnson-Neyman technique in model 1 of Hayes' macro). In sum, when switching off appliances is perceived to be relatively effortful, making a private commitment to engage in this behaviour strengthens one's personal norm to switch off appliances, which in turn promotes switching these appliances off.

Making a private commitment, perceived ease and its interaction were not related to switching off appliances via the injunctive norm. The mean indirect effect from the bootstrap analysis including injunctive norm, personal norm and environmental self-identity ($N = 1000$) shows that the private commitment, perceived ease and its interaction do not influence unplugging of appliances via the injunctive norm ($(a_1 + a_3 \times W) \times b = -.01$; 95% CI $[-.08, .02]$). Making a private commitment, perceived ease and the interaction between the private commitment and perceived ease explained 6.6% of the variance in injunctive norms, however this was not significant ($F(3, 80) = 2.20$, $p = .14$). Perceived ease was marginally significantly related to injunctive norms ($b = .23$, $p = .06$). Making a private commitment did not influence injunctive norms ($b = -.11$, $p = .51$). We also did not find an interaction effect between making a private commitment and perceived ease on injunctive norms ($b = -.05$, $p = .66$).

Making a private commitment, perceived ease and its interaction were not related to switching off appliances via environmental self-identity. The mean indirect effect from the bootstrap analysis including environmental self-identity, injunctive norm and personal norm ($N = 1000$) shows that the private commitment, perceived ease and its interaction do not influence unplugging of appliances via environmental self-identity ($(a_1 + a_3 \times W) \times b = -.01$; 95% CI $[-.09, .05]$). We found that making a private commitment, perceived ease and the interaction between the private commitment and perceived ease explained 16.8% of the variance in environmental self-identity ($F(3, 80) = 5.39$, $p < .01$). The easier people perceive switching off appliances to be, the stronger their environmental self-identity ($b = .21$, $p < .05$). Making a private commitment did not influence environmental self-identity ($b = -.20$, $p = .13$). We did find an interaction effect between making a private commitment and perceived ease on environmental self-identity ($b = -.22$, $p < .05$). Using the Johnson-

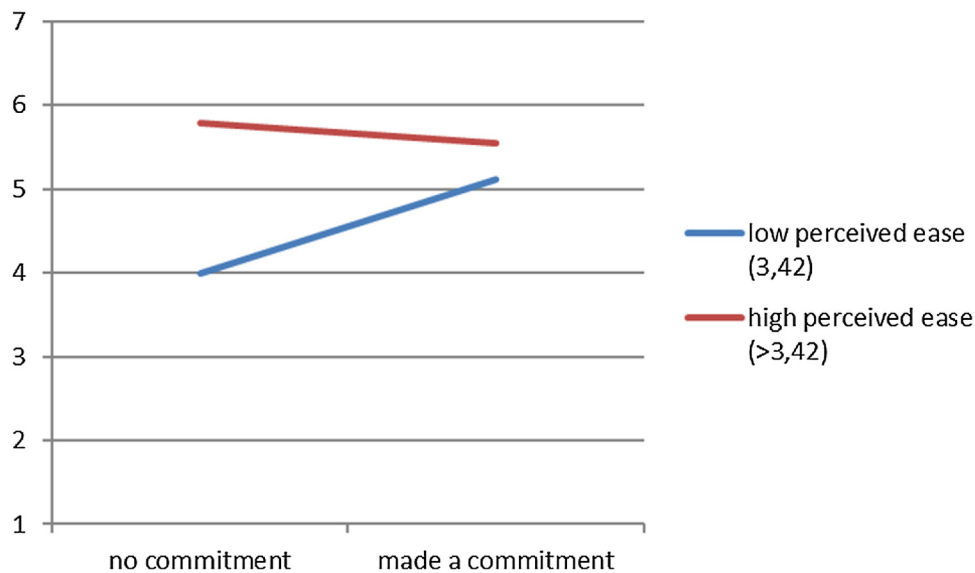


Fig. 2. The effect of the private commitment and perceived ease on switching off appliances.

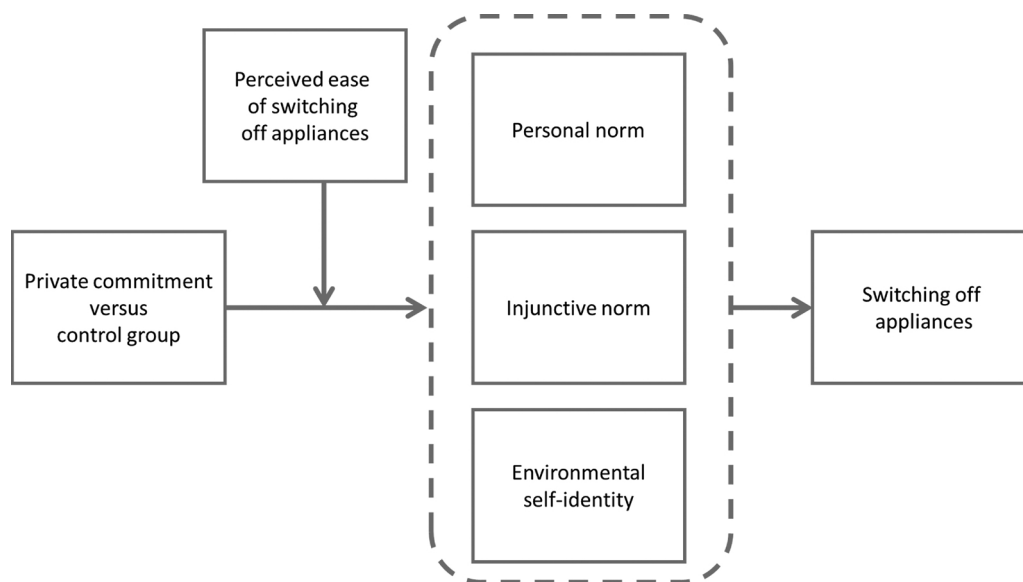


Fig. 3. The model tested.

Neyman technique in model 1 of Hayes' macro we no longer found that perceived ease moderates the influence of making a private commitment on environmental self-identity ($b = -.13, p = .15$). In this model personal norms and injunctive norms were no longer included. As personal norms and injunctive norms are related to perceived ease, excluding these variables from the model may reduce the strength of the interaction between perceived ease and the private commitment on environmental self-identity.

A regression analysis showed that personal norm, injunctive norm, environmental self-identity and making a private commitment explained 12.6% of the variance in switching off appliances ($F(4, 79) = 2.85, p < .05$). The stronger one's personal norm to switch off appliances, the more often people switch off appliances ($b = .24, p = .05$). The injunctive norm did not predict switching off appliances ($b = .13, p = .29$), neither did environmental self-identity ($b = .04, p = .78$) and the private commitment ($b = .00, p = .98$).

In sum, we found that the private commitment strategy strengthened personal norms when switching off appliances is perceived to be somewhat effortful. The private commitment strategy only

strengthened environmental self-identity when switching off appliances is perceived to be somewhat effortful if personal norms and injunctive norms are included in the model. When personal norms and injunctive norms are not included in the model the private commitment is no longer related to environmental self-identity when people find the behaviour somewhat effortful. The private commitment strategy did not influence injunctive norms when people find the behaviour somewhat effortful. Stronger personal norms were found to be related to switching off appliances. Injunctive norms and environmental self-identity were not related to switching off appliances. Furthermore, the private commitment only influenced switching off appliances when people find it somewhat effortful via personal norms.

4. Discussion

Research has shown that a private commitment strategy can promote pro-environmental behaviour such as saving energy. However, the question remains why this is the case. If we understand why a private commitment changes behaviour, private commitments can be adapted

in such a way that they are more likely to change the underlying mechanism and hence make it more likely to effectively change behaviour. Building on previous research [5,32,33] we argued that private commitments may make people feel morally obliged to engage in the behaviour they committed to thereby influencing the behaviour. That is, making a private commitment may strengthen one's personal norm to engage in the behaviour one committed to. We found that making a private commitment only promoted switching off appliances when the behaviour is perceived to be relatively effortful. Importantly, we found that making a private commitment to engage in relatively effortful energy saving behaviour strengthened people's personal norm for this behaviour, which in turn influenced the behaviour. Injunctive norms and environmental self-identity did not explain why making a private commitment changed energy saving behaviour if the behaviour is perceived to be relatively effortful.

4.1. The effect of the private commitment strategy on energy saving behaviour

We found that the private commitment only changed the desired behaviour when changing the behaviour was perceived to be somewhat effortful. This finding may be due to a ceiling effect. When switching off appliances is perceived to be relatively easy, people already did so to a large extent. Therefore, it was difficult to further improve the behaviour. Indeed, the participants in our sample already switched off appliances to a large extent and were more likely to do so the easier they perceive the behaviour to be. Interestingly, our findings suggest that overall it is not that effective to change behaviour using a private commitment strategy. This is in line with earlier research showing that overall private commitment strategies have a moderate effect on behaviour and do not always influence the target behaviour [5,42,43]. Our findings suggest that the effectiveness of private commitment strategies may depend on how effortful people find the behaviour. This is in line with the Attitude-Behaviour-Context (ABC) theory which suggests that individual factors are most strongly related to somewhat effortful behaviour ([44]; see also [45]). When behaviour is very easy to perform, everyone may engage in the behaviour, therefore a private commitment strategy may not further increase the likelihood of the behaviour. However, when the behaviour is very difficult a private commitment strategy may not be enough for people to engage in the desired behaviour. Therefore, private commitment strategies may be most likely to promote environmental behaviours that are somewhat difficult. Future research is needed to replicate our findings and systematically test which behaviours are influenced by a private commitment strategy. We measured perceived ease of switching off appliances overall. Future research could first test which behaviours people find easy or difficult [46]. Next, future research could test whether a private commitment strategy changes these behaviours. Furthermore, we measured perceived ease and self-reported behaviour at the same time, making it hard to draw any causal conclusions on this relationship. Perhaps people realized that they do not switch off many appliances and therefore indicated that they find it somewhat effortful to switch off appliances. Future research could manipulate the ease of the behaviour or measure perceived ease and behaviour at different points in time.

In our study we wanted to provide people with a choice on which appliances they privately commit to switch off to ensure they could commit to a behaviour that they are actually likely to change. Therefore, we included a list of appliances and participants could choose which appliance they want to switch off. Participants differed in the appliances they chose to commit to switch off. For example, switching off the television was the most frequently chosen appliance to switch off. Yet, still only 19 participants selected this appliance. As we were interested in the effect of the private commitment on a change in behaviour and its underlying mechanism we only wanted to include those appliances for which participants actually made a private commitment to change this behaviour. Therefore, for the private

commitment group we only tested effects on behaviours for which they made a private commitment that they will change this behaviour. However, for the control group we tested effects on all behaviours as they did not select appliances for which they could make a commitment to switch these off. We could not systematically compare each appliance as the statistical power would be too low, for example for some appliances only 10 people made a private commitment. It may be the case that participants who were asked to make a private commitment were most likely to commit to switch off specific types of appliances. For example, perhaps they mostly chose appliances they find relatively difficult to switch off as they already switch off the appliances for which they find it easy to do so. In that case relatively effortful behaviours of the private commitment group are compared to all behaviours in the control group, including the easy behaviours. Future research could systematically test the effectiveness of a private commitment separately for each behaviour compared to a control group that did not make a private commitment for this behaviour.

We tested our hypotheses for switching off appliances. However, research has shown that a private commitment strategy can influence a range of behaviours including changing transportation mode, recycling, and reducing towel use (see [5]). Therefore, we believe our findings are not only relevant for switching off appliances, but may also apply to other behaviours. From a practical perspective it is important to promote behaviours that have a large impact on the environment such as adopting energy efficient appliances [47,48]. However, impactful behaviours may be perceived as rather effortful as they are often quite costly, for example adopting an electric vehicle or solar panels. Based on our findings and the ABC theory [44], we expect that behaviours that are perceived to be somewhat effortful, are particularly likely to be influenced by a private commitment strategy. Effortful behaviours with a large environmental impact such as adopting an electric vehicle may be less likely to be influenced by a private commitment strategy. Future research is needed to test this. Furthermore, future research could also test which factors influence perceived ease of a behaviour. That way, private commitments can focus on those behaviours that are most likely to be influenced by a private commitment strategy.

We found that a private commitment strategy was related to energy saving behaviour one month later if people perceive the behaviour to be somewhat effortful. Importantly, we tested our hypotheses in an experimental design in which we randomly assigned participants to the conditions allowing us to draw conclusions on causality. However, experiments also have some limitations [49]. Specifically, our sample was relatively small. Only 103 out of 342 participants completed both the time 1 and the time 2 questionnaires. Furthermore, we found that participants in the control group were somewhat more likely to respond to the second questionnaire (34%), than participants in the private commitment group (26%). Perhaps particularly those respondents who did not act upon their commitment refrained from participating in the second questionnaire. To address the problem of drop-out, future research could for example study behaviour over time by observing the behaviour. Furthermore, we tested our hypotheses among a general sample consisting of zoo visitors. Future research could be conducted among a more representative sample. Also, future research is needed to test the effectiveness of private commitment strategies among larger samples as well as other samples, for example non-Western samples. Finally, we only contacted one person from the household, while switching off appliances takes place in a household setting and may be influenced by other household members as well [50]. Future research could include dynamics within the household when studying such behaviours.

We found that a large percentage of our participants did not make a private commitment to change their behaviour. Almost 25% (11 out of 47) did not do so. Other studies testing private commitment strategies among general samples of the population have found even lower percentages willing to make a commitment (e.g., [51]). This is important to take into account when using commitment strategies to promote

energy saving behaviour. Our results are based on the participants that did commit to change their behaviour. Therefore, the overall effect of a private commitment strategy on behaviour is likely to be even weaker because many people do not commit to any behaviour changes. Furthermore, to improve the effectiveness of commitment strategies it is important to test why participants are or are not willing to make a private commitment to change their behaviour. For example, people may be more likely to make a commitment when they perceive the behaviour to have a large environmental impact.

4.2. The process underlying the influence of a private commitment strategy

Our findings suggest that a private commitment promotes the desired behaviour when the behaviour is perceived to be somewhat effortful, via strengthening the extent to which people feel morally obliged to engage in the behaviour to which they committed. That is, if people perceive the behaviour to be somewhat effortful the private commitment strengthens one's personal norm to engage in the behaviour, which in turn promotes engagement in the behaviour. Scholars have suggested that personal norms may be the process underlying the effectiveness of private commitments [5,32,33] and the current study suggests this is indeed the case. Future research could test alternative models including the same variables, for example, whether personal norms influence the perceived effort of the behaviour.

In line with our expectations we found that when the behaviour is perceived to be somewhat effortful a private commitment did not influence behaviour via injunctive norms. A private commitment is not made visible to others. Therefore, others are not likely to know that one made a commitment. Future research is needed to test whether public commitments may strengthen injunctive norms in addition to personal norms. In fact, commitments made in public have been found to be more effective in promoting the desired behaviour compared to commitments made privately [52]. Perhaps both personal and injunctive norms are strengthened when commitments and the behaviour are public, therefore making the impact of the commitment on behaviour stronger. Future research is needed to address this question.

In line with our expectations we found that when people perceive the behaviour to be somewhat effortful a private commitment did not influence behaviour via the extent to which people see themselves as a pro-environmental person. Past behaviours may influence how one sees oneself when the behaviour clearly signals that one is a pro-environmental person [27]. Perhaps under certain circumstances, committing to behaviour may also signal that one is a pro-environmental person and thereby promote pro-environmental behaviour. Future research is needed to test the signalling strength of different types of private commitments and its influence on one how people see themselves. Furthermore, future research could test under which circumstances the signalling strength of a private commitment can be increased.

Our findings have implications for policy makers and practitioners. In some cases a private commitment can be a tool for policy makers and practitioners to promote energy saving behaviour. Our results suggest that private commitments should be used especially for behaviours that are perceived to be somewhat effortful as many people do not yet engage in these behaviours. For example, purchasing green energy or buying carbon offsets [46]. Furthermore, from a practical perspective strategies to change behaviour should particularly target behaviours that have a big environmental impact. We found that private commitments strengthen one's personal norm to engage in the behaviour when the behaviour is found to be somewhat effortful and thereby increase the likelihood that people engage in the behaviour. This suggests that private commitments can be made more effective when they more strongly influence the personal norm. For example, emphasizing the moral aspect of making the private commitment to save energy could strengthen the extent to which the private commitment influences one's personal norm to engage in the behaviour. By doing so, private commitments can change the target behaviour. Finally, in our study we

collaborated with a zoo. Our results suggest that overall a private commitment strategy is not a very effective strategy in changing energy saving behaviour in households. It is only an effective strategy for changing energy saving behaviours that are perceived as relatively effortful. However, an online commitment strategy is very easy and cost-effective to implement and can reach a large number of people. Therefore, overall it can contribute to energy saving, even when only energy saving behaviours that are perceived as effortful are promoted by the commitment. The zoo decided to implement an online commitment strategy to promote energy saving behaviour. Based on our findings we do not expect a large effect on behaviour, however when the behaviour is perceived to be somewhat effortful energy saving behaviour may be promoted.

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